EMBRY-RIDDLE AERONAUTICAL UNIVERSITY
Engineering Science

ES 312 – Fund. Of Energy Transfer
Homework Assignment 2
Due: 2/4/08

Properties:

	M (kg/kg-mole)	c_p (J/kg/^{o}K)
Air:	28.97	1004.
Water:	34.02	4180.
Nitrogen:	28.01	1039.
Hydrogen:	2.016	14430.

1) Air is expanded from 1000 kPa, 600^{o}C at the inlet of a steady-flow, adiabatic turbine to 100 kPa, 200^{o}C at the outlet. The inlet area and velocity are 0.1 m^2 and 30 m/s. The outlet velocity is 10 m/s. Determine the mass flow rate, outlet area, and power extracted.

2) Determine the flow work (kW) of a compressor that compresses hydrogen from 150 kPa, 20^{o}C to 400 kPa, 200^{o}C. The hydrogen enters this compressor through a 0.1 m^2 pipe at a velocity of 15 m/s. Neglect changes in elevation and assume adiabatic.

3) The water behind Hoover Dam in Nevada is 205 m higher than the Colorado River below it. At what rate (kg/sec) must water pass through the hydraulic turbines of this dam to produce 100 MW of power? (Hint: neglect change in temperature and velocity and assume adiabatic.)

4) An adiabatic gas turbine like expands air at 1000 kPa, 500^{o}C to 100 kPa, 150^{o}C. The air enters the turbine throught a 0.2 m^2 opening with a velocity of 40 ms and exhausts throught a 1 m^2 opening. Determine the turbine mass flow rate and power (kW) it produces.

5) The fan on a personal computer (PC) draws 14 liters/sec of air at 101.3 kPa, 21^{o}C through the box containing the CPU and other circuits. This air leaves at the same pressure and 27^{o}C. Calculate the electrical power (kW) dissipated by the PC circuits assuming the work done is zero.

6) A 110-V electrical hot-water heater warms 0.1 liter/s of water at 15oC to 20oC. Calculate the current in amperes that must be supplied to this heater. There is no work done and the changes in elevation and velocity are negligible.

7) Nitrogen is expanded in an isentropic turbine from 2000 kPa, 500^{o}C to 200 kPa. Determine the outlet temperature (^{o}C) and specific work (kJ/kg) produced by this turbine.